

1 "Turnout/Crossover Section for Railway Track"

2

3 The present invention relates to a turnout or
4 crossover section of railway track and particularly
5 but not exclusively relates to providing a temporary
6 non-intrusive turnout or crossover section of a
7 railway track.

8

9 Railway track requires to be maintained at regular
10 intervals and in order to do this, the section of
11 track that is being maintained must be cleared of
12 trains. The track is normally closed to traffic
13 often during no train periods and also out-with such
14 periods thus causing train cancellations or trains
15 being diverted to other routes for short or longer
16 terms (blockades). In some instances, the trains
17 are transferred from the track having the
18 maintenance performed on it onto an adjacent track
19 for a limited period (i.e. a few hours) and then
20 back onto the original track. The trains are
21 transferred onto the adjacent track by means of a
22 crossover section of track and returned by means of

1 a second crossover. This is known in the art as
2 "Single Line Working" (SLW). Conventionally, each
3 of the crossover sections are intrusive, in that the
4 section of track at which the crossover section is
5 inserted must be cut; this involves cutting the
6 existing rails of each railway track twice and
7 installing the temporary crossover and also
8 installing the switchgear along with providing an
9 interface for signalling. However, such an
10 intrusive crossover section is relatively expensive
11 and requires a fairly long time to plan and to
12 install, where the planning stage alone may take in
13 the region of 2 years. The only other known
14 alternative to solve this problem is to allow the
15 trains to crossover at the nearest permanent
16 crossover sections before and after the maintenance
17 site but these may be many miles away and thus if
18 repair or maintenance is required on only a few
19 metres of track, trains may be forced to share one
20 line of track for both directions (i.e. SLW) for
21 many miles or may be extensively diverted onto
22 alternative routes, thus leading to inefficiency and
23 delays.

24
25 Those in the rail industry will also realise that
26 there is a conflict between passengers who require
27 train services during the daytime and freight trains
28 which operate during the night and thus there is
29 very little time to effect such repairs and
30 maintenance. The overriding difficulty is access to
31 the track for cost efficient maintenance.

1 It will be understood by those skilled in the art
2 that a crossover comprises two individual turnouts,
3 where a turnout can be used on its own or can be
4 combined with another turnout to form a crossover.

5

6 In the context of this application, it should be
7 noted that a non-intrusive crossover is one that
8 does not pass through the rail to be crossed but
9 instead crosses over the rail to be crossed.

10

11 According to a first aspect of the present invention
12 there is provided a turnout for a railway track
13 comprising a pair of spaced apart rails, the turnout
14 comprising a raised track surface which is adapted
15 to provide a path along which the wheels of a train
16 can travel from one railway track to another,
17 wherein the raised track surface comprises first and
18 second portions and is arranged such that the wheels
19 of the train are first raised by the first portion
20 to a first rail crossing height and then lowered by
21 the second portion to a height at a location between
22 the pair of spaced apart rails of the railway track.

23

24 According to a first aspect of the present invention
25 there is also provided a method of transferring a
26 train from one railway track comprising a pair of
27 spaced apart rails to a second railway track
28 comprising a pair of spaced apart rails, the method
29 comprising the steps of:-

30 providing a raised track surface having a first
31 portion which comprises a raised portion and a
32 second portion which comprises a lower portion

1 provided at a location between the spaced apart
2 rails of the railway track, where the raised track
3 surface is adapted to provide a path along which the
4 wheels of the train can travel from the first to the
5 second railway track;

6 driving the train along the first track and
7 onto the raised track surface, wherein the first
8 raised portion of is of a sufficient height such
9 that the wheels of the train are arranged to clear
10 the pair of spaced apart rails of the railway track;
11 and

12 continuing to drive the train onto the second
13 lower portion of the raised track surface.

14

15 Preferably, the turnout is further adapted such that
16 the wheels of the train are first raised to a rail
17 crossing height in order for a first wheel to cross
18 a first rail, then lowered to a height at a location
19 between the pair of spaced apart rails, then raised
20 to the rail crossing height in order for a second
21 wheel to cross the first rail, then preferably
22 lowered to a height at a location between the first
23 and second railway tracks.

24

25 The invention has the advantage that it permits
26 short length Single Line Working without the need
27 for relatively high track portions in between the
28 spaced apart pair of rails of the railway track.

29

30 Preferably, a crossover comprises a pair of said
31 turnouts.

1 Typically, the first and/or second non-intrusive
2 crossover comprise a raised track surface, and
3 preferably the raised track surface is provided with
4 a supporting means to allow for passage of trains.

5

6 Typically, each of the first and second non-
7 intrusive crossovers comprise a pair of turnouts,
8 and preferably each pair of turnouts comprise a pair
9 of rails which form the raised track surface.

10

11 Typically, each rail of the turnout further
12 comprises at least a ramp surface, wherein, each
13 ramp surface is preferably tapered from a short or
14 no height end to a relatively tall height end. Most
15 preferably, each ramp surface comprises a linear
16 taper from the short or no height end to the
17 relatively tall height end, and preferably the
18 relatively tall height end is of the same height as
19 that of the first rail crossing height. Typically,
20 the relatively tall height end of the ramp surface
21 is adjacent to an end of the raised track surface at
22 its first rail crossing height, the two combining to
23 provide a path along which the wheel is permitted to
24 travel whilst maintaining a substantially equal
25 distance between a pair of raised rails, which
26 combined, form the raised track surface.

27 Preferably, the ramp surface comprises a ramp for
28 each rail of the railway track, where both ramps
29 preferably incline simultaneously, typically
30 avoiding differential levels, in relation to the
31 respective rails.

32

1 At least a crossing portion of each rail of the
2 raised track surface may comprise a slot formed
3 therein, typically below a rail head portion,
4 wherein the slot may be arranged to lie over or
5 around the rail being crossed and the rail head
6 portion is releasably fixed to the said rail being
7 crossed.

8
9 At least a crossing portion of each rail of the
10 raised track surface, which typically forms part of
11 a crossing rail, or a switch rail preferably
12 comprises a railhead portion arranged to lie over or
13 around a supporting member which in turn is
14 preferably arranged to lie over or around the rail
15 being crossed. Preferably, the supporting member is
16 arranged with its longitudinal axis being parallel
17 to the rails of the parent rail. Preferably, the
18 supporting member comprises at least an upper
19 supporting member and at least a lower supporting
20 member. Preferably, the upper supporting member is
21 planar and more preferably, the upper surface of the
22 upper supporting member is attached to the a lower
23 surface of the crossing portion of the raised track.
24 Preferably, at least another portion of the raised
25 track surface, which is typically the ramp surface,
26 is supported by the parent rail and a fixing means.

27
28 Typically, the upper supporting planar member is
29 substantially wider than an existing rail of one of
30 the first and second railway tracks.

31

1 Preferably, the upper supporting planar member is
2 rectangular in shape, and more preferably, is in the
3 form of a plate.

4
5 Preferably, a pair of guide means are provided along
6 at least a portion of the upper supporting member's
7 length. Preferably the guide means run parallel to
8 the upper supporting member's longitudinal axis, and
9 more preferably, project downwardly in order, in
10 use, to straddle an existing rail of the first and
11 second existing railway tracks.

12
13 Preferably, a pair of lower supporting members are
14 provided at either side of at least a portion of the
15 existing rail.

16
17 Preferably, the pair of lower supporting members
18 combine to provide a substantially similar shape,
19 width and position along the existing railway track
20 as the upper supporting member, and are adapted to
21 be releasably engaged thereto and more preferably,
22 releasably fixed thereto, wherein the lower surface
23 of the upper supporting planar member preferably
24 lies on top of the uppermost surface of the lower
25 supporting members. Most preferably, the upper
26 supporting member is moveably coupled to at least
27 one of the lower supporting members, typically by a
28 hinge means. The hinge means has the advantage of
29 permitting the upper supporting member to move
30 between a first configuration in which the upper
31 supporting member is arranged in a substantially
32 horizontal plane and rests upon the pair of lower

1 supporting members over the existing rail of the
2 railway track and a second configuration in which
3 the upper supporting member is remote from the
4 existing rail such that a train wheel may be driven
5 along the existing rail in "normal running".
6 Preferably, the upper supporting member is moved
7 from the first to the second configuration by
8 rotating the upper supporting member about the hinge
9 means relative to the lower supporting member.

10

11 Alternatively, the lower supporting members combine
12 to be longer and/or wider than the upper supporting
13 member.

14

15 According to a second aspect of the present
16 invention there is provided a turnout for a railway
17 track comprising a pair of spaced apart rails, the
18 turnout comprising a raised track surface which is
19 adapted to provide a path along which the wheels of
20 a train can travel from one railway track to
21 another, wherein the raised track surface comprises
22 a crossing rail portion adapted to cross over one of
23 the spaced apart rails, the crossing rail portion
24 being coupled to an upper supporting member which,
25 in use, rests upon and is supported by at least one
26 lower supporting member, characterised in that the
27 upper and at least one lower supporting members are
28 coupled to one another by a moveable mechanism.

29

30 Preferably, there are a pair of lower supporting
31 members which typically combine to provide a
32 substantially similar shape, width and position

1 along the existing railway track as the upper
2 supporting member. Preferably, the upper supporting
3 member comprises a substantially planar member and
4 more preferably, the lower surface of the upper
5 supporting planar member lies on top of the
6 uppermost surface of the lower supporting members.
7 Most preferably, the moveable mechanism comprises a
8 hinge mechanism. The hinge mechanism is typically
9 arranged to permit the upper supporting member to
10 move between a first configuration in which the
11 upper supporting member is arranged in a
12 substantially horizontal plane and rests upon the
13 pair of lower supporting members over the existing
14 rail of the railway track and a second configuration
15 in which the upper supporting member is remote from
16 the existing rail such that a train wheel may be
17 driven along the existing rail in "normal running".
18 Preferably, the upper supporting member is moved
19 from the first to the second configuration by
20 rotating the upper supporting member about the hinge
21 means relative to the lower supporting member.

22
23 Preferably, normal running of a train along the
24 first and/or second existing railway track(s) may be
25 allowed, where the train does not travel between the
26 first and second existing railway tracks by moving
27 or removing one or more sections of the crossover
28 from engagement with the first and/or second
29 existing railway tracks. Preferably, the one or
30 more moveable or removable sections comprise at
31 least a ramp, a first raised portion of the raised
32 track surface, at least an upper supporting member,

1 and leaving in place the second lower portion of the
2 raised track surface, and may include leaving in
3 place at least one of the lower supporting members.
4

5 In a first embodiment, the second lower portion of
6 the raised track surface is adapted to be at a
7 height which is lower than the first raised portion.
8 This has the advantage of preventing the second
9 lower portion from protruding above the horizontal
10 plane defined by the upper surface of the existing
11 rails of the railway track by more than an
12 acceptable level during normal running.
13

14 Typically, at least the crossing portion of the
15 raised track surface, is formed on top of a rail
16 head portion or more particularly when referring to
17 the crossing rail, a raised crossover member,
18 wherein the height of the raised crossover member at
19 least equals, and is preferably greater than, the
20 depth of a flange portion of the wheel of the train.
21

22 Typically, the raised track surface comprises a
23 plurality of rail members, one or more of which
24 comprise a curved radius away from one of the
25 railway tracks towards the other railway track.
26

27 Preferably, the plurality of rail members combine to
28 form a turnout having a substantially continuous
29 rail surface and includes the following components:-

30 the said first portion which includes a ramp
31 member adapted to raise the train wheel to the rail
32 crossing height;

1 a curved radius rail adapted to urge the train
2 away from one of the railway tracks towards the
3 other railway track;

4 the second portion which includes a further
5 ramp member adapted to lower the train wheel to a
6 lower height at a location in between the pair of
7 spaced apart rails of the railway track;
8 another first portion which includes a further ramp
9 member to raise the train wheel from the lower
10 height to a rail crossing height; and

11 a crossover rail adapted to allow the train to
12 pass over an inner rail of the first existing
13 railway track at the raised height.

14

15 The turnout may then further comprise another second
16 portion which includes a further ramp member adapted
17 to lower the train wheel to a lower height at a
18 location in-between the inside rails of the first
19 and second railway tracks;

20

21 Typically, at least a portion of the raised track
22 surface, such as the substantially straight rail, is
23 supported in the lateral and or vertical direction
24 at a plurality of locations along its length by a
25 support device. Preferably, the support device
26 comprises a plurality of sleeper supports and more
27 preferably comprises a plurality of pot sleeper
28 arrangements.

29

30 Preferably, the one or more turnouts are temporary
31 turnouts and more preferably are non-intrusive
32 turnouts.

1 Typically, the pot sleeper arrangements comprise a
2 body having an, in use, substantially planar upper
3 surface onto which rails may be connected;
4 front and rear faces which extend downwardly at
5 an angle to the upper surface, the faces having
6 lower contact edges for contact with the ground; and
7 a pair of side ends which extend downwardly at
8 an angle to the upper surface for a greater distance
9 than the front and rear faces.

10

11 The pot sleeper arrangements have the advantage that
12 the pair of side ends project, in use, into the
13 ground thereby providing resistance against lateral
14 (side to side) movement of the pot sleeper, whilst
15 the main weight of the pot sleeper, rail and train
16 is borne by the contact edges and/or the underside
17 of the substantially planar upper surface.

18

19 Preferably, said lower contact edges having a
20 greater surface area than the cross-sectional area
21 of the front and rear sides.

22

23 Preferably, the front and rear faces combine with
24 the upper surface to form an inverted 'U' shaped
25 body, whilst the pair of side ends combine to close
26 the longitudinal axis of the 'U' shaped body.

27 Preferably, the body is hollow, where the hollow
28 body may be partially or wholly filled with a
29 filling material and more preferably, the contact
30 edges are formed by lips which project either
31 inwardly or outwardly from the body (preferably

1 outwardly) to provide a greater surface area to the
2 body on the, in use, horizontal plane.

3

4 Typically, the upper surface is provided with a
5 coupling mechanism to permit coupling of the pot
6 sleeper to a rail. Preferably, a connection
7 mechanism is provided to couple a first to a second
8 respective pot sleeper, where the connection
9 mechanism may include a substantially rigid member
10 which extends therebetween. Typically, the
11 substantially rigid member may be arranged to pass
12 underneath the rails of the existing railway track.

13

14 Preferably, the pot sleepers are driven into ground
15 ballast by a mechanical means which may be a
16 vibrating mechanism means. Typically, further
17 ballast or other material may be inserted into the
18 hollow body to maintain/increase the height of the
19 pot sleeper, in use.

20

21 According to a third aspect of the present invention
22 there is provided a turnout for a railway track
23 comprising a pair of spaced apart rails, the turnout
24 comprising a raised track surface which is adapted
25 to provide a path along which the wheels of a train
26 can travel from one railway track to another,
27 wherein the raised track surface comprises a ramp
28 member to permit a wheel of a train to enter the
29 raised track surface, the ramp member comprising:-
30 a fixing mechanism to releasably secure the
31 ramp member to one of the spaced apart rails;

1 an upper ramp surface which in use provides a
2 rail surface for a tread of the wheel to traverse;
3 and

4 a lead-in portion which is arranged at one side
5 of the said one of the spaced apart rails, wherein
6 the lead-in portion comprises an upper rail surface
7 which, in use, is inclined at an angle to the
8 horizontal axis and which provides a rail surface
9 for a portion of the tread to traverse.

10

11 Preferably, the upper rail surface of the lead-in
12 portion is arranged to lie at one side of the said
13 one of the spaced apart rails and has an outermost
14 end which is arranged to be located at a height
15 lower than the upper rail surface of the said one of
16 the spaced apart rails and an innermost end which
17 merges into the rest of the upper rail surface of
18 the ramp member.

19

20 Preferably, the portion of the ramp member which
21 merges from the lead-in portion to the rest of the
22 upper rail surface is also arranged at an angle
23 between the transverse direction of the rail surface
24 and the longitudinal axis of the rail surface.

25

26 Embodiments of the present invention will now be
27 described, by way of example only, with reference to
28 the accompanying drawings, in which:-

29

30 Fig. 1 is a plan view of temporary non-
31 intrusive turnout as described in our co-pending
32 International (PCT) Application No PCT/GB03/03555;

1 Fig. 2 is a plan view of a portion of the
2 turnout of Fig. 1 highlighted as detail 1;

3 Fig. 3a is a cross-sectional view across
4 section B-B of Fig. 2;

5 Fig. 3b is a side view of a portion of the
6 turnout shown in the direction of A-A of Fig. 2;

7 Fig. 4 is a close up view of a G-clamp
8 indicated in Fig. 6 as detail 2;

9 Fig. 5 is a close up view of a G-clamp of Fig.
10 7a indicated as detail 3;

11 Fig. 6 is a cross-sectional view across section
12 C-C of Fig. 1;

13 Fig. 7a is a cross-sectional view across
14 section D-D of Fig. 1;

15 Fig. 7b is a side view of the portion of the
16 turnout shown in Fig. 7a;

17 Fig. 8 is a cross-sectional view across section
18 E-E of Fig. 1;

19 Fig. 9a is a close up plan view of the portion
20 of the turnout indicated in Fig. 1 as detail 4;

21 Fig. 9b is a cross-sectional view across
22 section F-F of Fig. 9a;

23 Fig. 10 is a perspective view of a scale model
24 of a temporary non-intrusive turnout, substantially
25 identical to that shown in Fig. 1 during
26 installation;

27 Fig. 11 is a perspective view of the turnout
28 section of Fig. 10 further on during construction;

29 Fig. 12 is a perspective view of the turnout
30 section of Fig. 11 further on during construction;

31 Fig. 13 is a perspective view of the turnout
32 section of Fig. 12 further on during construction;

1 Fig. 14 is a plan view of one end of the
2 turnout section of Fig. 13;

3 Fig. 15 is a perspective view of a model
4 representing a train as it enters the turnout
5 section of Fig. 14;

6 Fig. 16 is a perspective view of the model of
7 Fig. 15 as it progresses through the turnout
8 section;

9 Fig. 17 is a perspective view of the model of
10 Fig. 16 as it progresses further through the turnout
11 section;

12 Fig. 18 is a perspective view of the model of
13 Fig. 17 as it nears the end of the turnout section;

14 Fig. 19a is a plan view of an alternative
15 switch rail to that shown in Fig. 1, where the
16 switch rail is mounted on a support plate;

17 Fig. 19b is a cross-sectional view of the
18 switch rail of Fig. 19a;

19 Fig. 19c is a plan view of the switch rail and
20 support plate of Fig. 19a;

21 Fig. 19d is a side view of the support plate of
22 Fig. 19a;

23 Fig. 19e is a side view of an end of the switch
24 rail of Fig. 19a;

25 Fig. 19f is an end view of the end of the
26 switch rail of Fig. 19e;

27 Fig. 20a is a plan view of an alternative
28 embodiment of crossing rail to that shown in Fig. 1;

29 Fig. 20b is a cross-sectional view of the
30 crossing rail of Fig. 20a;

31 Fig. 20c is a side view of an end of the
32 crossing rail of Fig. 20a;

1 Fig. 20d is an end view of the end of the
2 crossing rail of Fig. 20c;

3 Fig. 21a is a plan view of the crossing rail of
4 Fig. 20a as it crosses an existing rail of a railway
5 track;

6 Fig. 21b is a cross-sectional view of the
7 crossing rail taken through the line A-A of Fig.
8 21a;

9 Fig. 21c is a plan view of the crossing rail of
10 Fig. 21a without the existing rail for clarity;

11 Fig. 21d is a side view of the crossing rail of
12 Fig. 21c;

13 Figs. 22a, b, c and d are side views of
14 possible/optional gutt rail deflecting means for use
15 with a gutt rail of the turnout of Fig. 1;

16 Fig. 23a is a plan view of level crossing
17 support members for supporting the switch rail of
18 Fig. 19a;

19 Fig. 23b is a cross-sectional view of level
20 crossing support members of Fig. 23a;

21 Fig. 23c is a detailed plan view of level
22 crossing support members for supporting the crossing
23 rails of the turnout of Fig. 1;

24 Fig. 23d is a cross-sectional view of the level
25 crossing support members and the crossing rail of
26 Fig. 23c;

27 Fig. 23e is an plan overview showing the
28 position of the level crossing support members of
29 Fig. 23c within the crossover;

30 Fig. 24a is a perspective view of a further
31 turnout as described in our co-pending International
32 (PCT) Application No PCT/GB03/03555;

1 Fig. 24b is a plan view of the switch rail and
2 ramp rails and associated level crossing support
3 members of the turnout of Fig. 24a;

4 Fig. 24c is a perspective view of the temporary
5 turnout of Fig. 24a, also showing an arrangement of
6 pot sleepers as described in our co-pending
7 International (PCT) Application No PCT/GB03/03555;

8 Fig. 25a is a side view of the ramp rails
9 leading onto the switch rails of the turnout of Fig.
10 24a;

11 Fig. 25b is side view showing one of the train
12 wheels mid-way up the ramp rail of Fig. 25a;

13 Fig. 26 is a perspective view showing the ramp
14 rail and clamping mechanism;

15 Figs. 27a and 28a are perspective view
16 photographs showing the crossing rail of Fig. 24a
17 during installation;

18 Figs. 29a, b, c, d are end view photographs
19 showing the train wheels passing a portion of the
20 support members of Fig. 24b during normal running;

21 Fig. 29a and 29f show the support members and
22 gutt rails of Fig. 29a in position during normal
23 running;

24 Fig. 29g is a perspective view showing the
25 support members of Fig. 29a prior to installation;

26 Fig. 30 is a perspective view showing the train
27 passing over the crossing rails of Fig. 29a, whilst
28 clearing the main tracks;

29 Fig. 31a and 31b are perspective view
30 photographs taken during installation of the ramp
31 rails and switch rails of Fig. 29a;

1 Fig. 32a is a plan view showing the layout of
2 the pot sleepers of Fig. 24c;

3 Fig. 32b is a plane view showing two pot
4 sleeper arrangements of Fig. 24c connected by a
5 rigid frame;

6 Fig. 32c shows an end, side, and plan view of
7 the pot sleeper arrangement of Fig. 24c;

8 Fig. 33a is a perspective view showing the pot
9 sleeper and rigid frame arrangements of Fig. 32b in
10 their operational position;

11 Fig. 33b is a perspective view of the pot
12 sleeper arrangement of Fig. 24c with a sample rail
13 section fixed thereto;

14 Fig. 34a is side view of the pot sleeper
15 arrangement of Fig. 24c with a sample rail section
16 fixed thereto;

17 Fig. 34b is a perspective view showing the pot
18 sleeper arrangement and switch rail of Fig. 24c in
19 their operational positions;

20 Fig. 35a and 35b are perspective view
21 photographs showing the layout of the pot sleeper
22 arrangements of Fig. 24c;

23 Fig. 36a is a plan view of a crossover in
24 accordance with the first and second aspects of the
25 present invention, where the crossover rail is
26 mounted on a support plate which is in a first
27 configuration;

28 Fig. 36b is a plan view of the crossover rail
29 and support plate of Fig. 36a;

30 Fig. 36c is a plan view of the crossover rail
31 of Fig. 36a;

1 Fig. 36d is a cross-sectional view of the
2 crossover rail of Fig. 36a;

3 Fig. 36e is a cross-sectional view of the
4 crossover rail of Fig. 36a with the support plate
5 and crossover rail hinged to one side in a second
6 configuration;

7 Fig. 36f is an end view of the end of the
8 crossover rail of Fig. 36a;

9 Fig. 37a is a plan view of a switch rail in
10 accordance with the first and second aspect of the
11 present invention, where the switch rail is mounted
12 on a support plate which is in a first
13 configuration;

14 Fig. 37b is a plan view of the switch rail and
15 support plate of Fig. 37a;

16 Fig. 37c is a plan view of the switch rail of
17 Fig. 37a;

18 Fig. 37d is a cross-sectional view of the
19 switch rail of Fig. 37a;

20 Fig. 37e is a cross-sectional view of the
21 crossover rail of Fig. 37a with the support plate
22 and switch rail hinged to one side in a second
23 configuration;

24 Fig. 38a is a plan view of a temporary non-
25 intrusive turnout in accordance with a first aspect
26 of the present invention;

27 Fig. 38b is a schematic diagram illustrating
28 the height variation along the length of the
29 temporary non-intrusive turnout of Fig. 38a;

30 Fig. 39a is transverse view of a ramp in
31 accordance with the first and third aspect of the
32 present invention;

1 Fig. 39b is a plan view of the ramp of Fig.
2 39a;

3 Fig. 39c is a cross sectional view illustrating
4 train wheels being supported by the ramps of Fig.
5 39a; and

6 Fig. 39d is a more detailed cross sectional
7 view of the ramps of Fig. 39c.

8
9 Fig. 1 shows a non-intrusive turnout generally
10 indicated as 10.. It will be appreciated by the
11 reader that two spaced apart non-intrusive turnouts
12 10 are utilised on a section of track to provide a
13 non-intrusive crossover.

14
15 As shown in Fig. 1, the temporary non-intrusive
16 turnout 10 links a south bound rail track 12 and a
17 north bound rail track 14, such that a train (not
18 shown) which has already been transferred from the
19 south bound rail track 12 to travel south along the
20 north bound rail track 14 can be transferred back
21 onto the south bound rail track 12. In this manner,
22 the portion of the south bound rail track 12' can be
23 repaired/maintained. The skilled reader will
24 realise that other routes of transfer could be
25 installed and adopted.

26
27 The temporary non-intrusive turnout 10 comprises a
28 number of components which will now be described.

29
30 The non-intrusive turnout 10 comprises a pair of
31 turnout tracks 16, 18 and a plurality of temporary
32 sleepers 20. For ease of reference, the turnout

1 track 16 will be referred to as the left hand
2 turnout track 16 and the turnout track 18 will be
3 referred to as the right hand turnout track 18.
4

5 The left hand turnout track 16 comprises, from the
6 left hand end of Fig. 1, a ramp rail 22L. The
7 uppermost portion of the ramp rail 22L is wedge
8 shaped, with the uppermost surface tapering linearly
9 from its left most end which has a height of 0mm up
10 to its right most end which has a height of
11 approximately 50mm and this linear tapering can be
12 best seen in Figs. 7B, 25A and 25B which shows that
13 the ramp rail 22 has a sufficient length, in the
14 region of 1700mm, such that the angle of tapering is
15 relatively gradual. The ramp rail 22L is coupled to
16 the north bound left hand rail track 14L by means of
17 a G-clamp mechanism 32 as shown in Fig. 5; it should
18 be noted however that other types of clamp
19 mechanisms could be utilised. The ramp rail 22
20 comprises a head portion 51 which rests on top of
21 the upper flat surface of the rail track 12, 14. A
22 neck portion 53 extends downwardly from the inner
23 most edge of the head portion 51, where the neck
24 portion 53 is shaped to substantially match the
25 shape of the inside face of the rail track 12, 14.
26

27 The G-clamp mechanism 32 comprises a G-shaped clamp
28 34, one end of which surrounds and is compressed
29 against, the opposite upstanding face of the rail
30 track 12, 14 to the neck portion 53. A vice 36
31 extends toward the neck portion 53 of the ramp rail
32 22 from the other end of the G-shaped clamp 34, such

1 that the vice 36 can be forced or urged into secure
2 connection with the neck portion 53. Preferably,
3 the vice 36 is of a type that can be readily
4 assembled and disassembled in a short amount of
5 time.

6
7 Following on from the ramp rail 22L from left to
8 right, the left hand turnout track 16 next comprises
9 a switch rail 24L, the left hand most end of which
10 is arranged to butt against the right hand most end
11 of the ramp rail 22L, as shown in Fig. 7b. As shown
12 in Fig. 6, the switch rail 24L, 24R comprises a
13 respective head portion 55L, 55R and the switch rail
14 24L, 24R is inwardly curved along its length, toward
15 the south bound rail track 12 and thus away from the
16 north bound rail track 14. In other words, the end
17 of the switch rail 24L adjacent to the ramp rail 22L
18 is located directly above the north bound rail track
19 14L whilst the opposite end of the switch rail 24L
20 is displaced from the north bound rail track 14L.
21 Nevertheless, the head portion 55L comprises a
22 linear height of approximately 50mm arranged
23 horizontally along its length. The switch rail 24L
24 also comprises a neck portion 57L. Conveniently,
25 and as shown in Fig. 4, the neck portion 57L may
26 have a slot formed in it at the end of the switch
27 rail 24L closest to the ramp rail 22L, such that the
28 upper most portion of the north bound rail track 14L
29 can protrude inwardly through said slot.
30 Alternatively, the slot may be omitted, with the
31 neck portion 57L following the shape of the inside
32 face of the north bound rail track 14L. The switch

1 rail 24L is secured in a releasable fashion to the
2 north bound rail track 14L by means of a G-clamp
3 mechanism 62 which operates in a similar fashion to
4 the G-clamp mechanism 32 of Fig. 5. The G-clamp
5 mechanism 62 as shown in Fig. 4 comprises a similar
6 G-shaped clamp 64 and a vice 66. The switch rail
7 24L is supported at its middle and right hand most
8 end from underneath by the G-clamp mechanism 62 and
9 temporary sleepers 20. It should be noted that the
10 term "inside face" is used in the sense that it is
11 the face that the respective turnout track 16, 18 is
12 being turned away from.

13

14 Following on from the switch rail 24L from left to
15 right, the left hand turnout track 16 next comprises
16 a gutt rail 26L. The gutt rail 26L has an I-shaped
17 cross-section which is broadly similar to the I-
18 shaped cross-section of a normal rail track such as
19 12, 14. The gutt rail 26L continues to bend at
20 approximately the same radius as the bend radius of
21 the switch rail 24L. The clamping mechanism of the
22 gutt rail 26L to the north bound rail track 14L is
23 similar to that as shown in Fig. 8 which will be
24 described subsequently. Again, the gutt rail 26L is
25 supported from underneath by the clamping mechanism
26 and temporary sleepers 20 to have its upper flat
27 horizontal surface to be approximately 50mm above
28 the south bound 12 and hence north bound 14 rail
29 tracks.

30

31 Up until this point, the right hand turnout track 18
32 substantially mirrors that of the left hand turnout

1 track 16, since the right hand turnout track 18
2 comprises, from left to right in Fig. 1, a ramp rail
3 22R, a switch rail 24R and a gutt rail 26R.

4
5 The left hand turnout track 16 from left to right
6 after the gutt rail 26L comprises a straight rail
7 28L which thus has no bend radius and which once
8 again is supported by the temporary sleepers 20 to
9 have its upper flat horizontal surface to be
10 approximately 50mm above the south bound 12 and
11 hence north bound 14 rail tracks.

12
13 Following immediately on from the straight rail 28L,
14 the left hand turnout track 16 comprises a crossing
15 rail 30L which is broadly similar to the crossing
16 rail 30R which will be described subsequently.

17
18 Immediately following on from the gutt rail 26R, the
19 right hand turnout track 18 comprises a crossing
20 rail 30R which is shown in more detail in Fig. 2 and
21 Figs. 3A and 3B. The crossing rail 30R comprises a
22 substantially I-shaped cross-section toward and at
23 both its ends which is substantially the same I-
24 shaped cross-section as the existing south bound 12
25 and north bound 14 rail track. Thus, towards and at
26 its ends, the crossing rail 30R comprises a head
27 portion 59 and a neck portion 61. However, a slot
28 or gap 31 is provided along a portion of the length
29 of the crossing rail 30R about the mid point of the
30 crossing rail 30R such that there is no neck portion
31 61 in the region of the slot 31 as shown most
32 clearly in Fig. 3B. The crossing rail 30R is

1 arranged to lie across the north bound rail track
2 14L such that the north bound rail track 14L lies
3 within the slot 31. Accordingly, since the crossing
4 rail 30R is again supported from underneath by the
5 temporary sleepers 20 to have its head portion 59
6 with a height of approximately 50mm and since the
7 crossing rail 30R is arranged to be horizontal, the
8 upper most surface of the crossing rail 30R is
9 approximately 50mm higher than the upper most
10 surface of the south bound 12 and north bound 14
11 rail tracks.

12

13 The right hand turnout track 18 next comprises from
14 left to right and immediately after the crossing
15 rail 30R, a straight rail 28R which is substantially
16 identical in function and arrangement to the
17 straight rail 28L previously described. Similarly,
18 the crossing rail 30L is substantially identical to
19 the crossing rail 30R in function and arrangement
20 except that the crossing rail 30L crosses over the
21 south bound rail track 12R.

22

23 The left hand turnout track 16 follows on from left
24 to right after the crossing rail 30L with a gutt
25 rail 42L which is followed by a switch rail 44L
26 which is in turn followed by a ramp rail 46L which
27 are respectively substantially identical to the gutt
28 rails 26L, switch rail 24L and ramp rail 22L in
29 function and arrangement.

30

31 The right hand turnout track 18 follows on from the
32 straight rail 28R from left to right with a gutt

1 rail 22R which is followed by a switch rail 44R
2 which is in turn followed by a ramp rail 46R which
3 are respectively substantially identical in function
4 and arrangement to the gutt rail 26R, the switch
5 rail 24R and the ramp rail 22R.

6
7 As shown in Fig. 8, the gutt rails 42L, 42R (and
8 thus the gutt rails 26L, 26R) are clamped to the
9 south bound rail tracks 12L, 12R by means of a J
10 block arrangement 68L, 68R and a lengthened G-clamp
11 mechanism 70L, 70R. The J block arrangement 68L and
12 G-clamp mechanism 70L will now be described, but
13 those skilled in the art will realise that the J
14 block arrangement 68R and G-clamp mechanism 70R are
15 substantially identical to the J block arrangement
16 68L and G-clamp mechanism 70L except that they are
17 rotated through 180°. The gutt rail 42L is spaced
18 apart from the south bound rail track 12L by means
19 of the J block arrangement 68L which is preferably
20 formed from any hard material that is shaped to fit
21 into the heart of the rail to maintain a set
22 distance between the rails. As shown in Fig. 8, the
23 J block arrangement 68L is arranged such that it not
24 only spaces the gutt rail 42L horizontally apart
25 from the south bound rail track 12L but it also
26 spaces them vertically apart, such that the upper
27 most horizontally arranged surface of the gutt rail
28 42L is approximately 50mm vertically above the upper
29 most horizontally arranged surface of the south
30 bound rail track 12L. The G-clamp mechanism 70L
31 clamps the gutt rail 42L to the south bound rail
32 track 12L via the J block arrangement 68L and the G-

1 clamp mechanism 70L once again comprises a vice 76L
2 or a bolted fixing through the rail 12L, 42L and J
3 block arrangement 68L or similar arrangement.

4
5 It should be noted that, as shown in Fig. 9A, the
6 left hand 16 and right hand 18 turnout tracks may be
7 provided with a pot sleeper arrangement 80, where
8 the two pot sleeper arrangements 80L, 80R are
9 coupled to one another via a rigid frame 82L, 82R,
10 where the rigid frame 82L, 82R may be provided in
11 two halves, 82L, 82R which are coupled to one
12 another at their outer most ends via a suitable
13 fixing means 84 such as nuts and bolts (not shown).
14 Thus, the pot sleeper arrangement 80L, 80R can be
15 used either to replace the temporary sleepers 20 (as
16 shown in Figs. 32A and 33A) or could be provided on
17 top of an in-situ or existing timber sleeper, in
18 order to provide increased rigidity to the non-
19 intrusive temporary turnout 10.

20
21 The pot sleeper arrangement 80 is shown in more
22 detail in Figs. 33B and 34A with a sample rail
23 section 86 fixed in position. The beam section 84
24 of the pot sleeper 80 has a hollow, inverted U-
25 shaped cross section which is toed out at the
26 lowermost end of each side of the inverted, U-shape
27 to form lips 88. End plates 90 are attached to each
28 end of the beam section 84 such that each end plate
29 90 protrudes vertically downward past the lips 88,
30 the downward projection typically being in the
31 region of 100mm. The sample rail section 86 is
32 connected to the beam section 84 by conventional

1 'Pandrol' clips 92 which are known widely in the
2 railway industry.

3
4 When the pot sleepers 80 are in position, the end
5 plates 90 project into the ballast or stones(not
6 shown in Fig. 33B) until the lips 88 are level with
7 the ballast (not shown). This projection of the
8 plates 90 provides increased lateral stability to
9 the pot sleepers 80 in both the longitudinal and
10 perpendicular directions with respect to the main
11 axis of the pot sleepers 80, whilst keeping the mass
12 of the pot sleeper arrangement 80 to a minimum. The
13 lips 88 also create a larger surface area or
14 footprint for the pot sleeper 80 which avoids it
15 sinking into the ballast (not shown) beyond a
16 satisfactory depth when a load is placed on the pot
17 sleeper 80 (i.e. during the passing of a train 5).

18
19 Fig. 10 shows a scale model of a non-intrusive
20 turnout 10 part way through construction; it should
21 be noted however that the scale model shown in Fig.
22 10 omits the straight rails 28L, 28R and also the
23 switch rails 44L, 44R but it is envisaged that the
24 straight 28L, 28R and switch 44L, 44R rails would be
25 used in a full size rail track 12, 14.

26
27 Fig. 10 shows that a couple of temporary sleepers 20
28 have been laid, and the gutt rails 42L, 42R have
29 been secured to the temporary sleepers 20 and also
30 secured to the south bound track 12L, 12R. It
31 should also be noted that the gutt rails 42R are in
32 essence longer versions of the switch rails 44L, 44R

1 in the model shown in Fig. 10 through Fig. 18. The
2 crossover rail 30L has also been installed such that
3 it crosses over the south bound rail track 12R.
4 Fig. 11 shows that the gutt/switch rail 26L has been
5 installed next and is followed by installation of
6 the gutt/switch rail 26R in Fig. 12 and is followed
7 by the crossover rail 30R as shown in Fig. 13.
8 Thereafter, the ramp rails 22L, 22R are secured to
9 the respective north bound rail tracks 14L, 14R.
10
11 A model of a train 5 is shown in Fig. 15 as having
12 travelled south along the north bound rail track 14
13 and having mounted the ramp rails 22L, 22R. It is
14 important to note that the ramp rails 22L, 22R raise
15 the wheels of the train (not shown) and thus the
16 model train 5 by an amount sufficient such that the
17 flanged part of the wheel is just vertically above
18 the height of the rest of the normal track 14L, 14R.
19 Thus, and as shown in Fig. 16, when the model train
20 5 moves onto the crossing rails 30L, 30R, the left
21 hand 16 and right hand 18 turnout tracks are of a
22 sufficient height such that the flanged part of the
23 wheel 7, which normally acts to keep the model train
24 5 and thus full size trains on the tracks, is able
25 to clear the north bound rail track 14L and then the
26 south bound rail track 12R. The model 5 is shown in
27 Fig. 17 as continuing through the non-intrusive
28 temporary turnout 10 until it reaches the position
29 shown in Fig. 18 which shows the model 5 about to
30 travel down the ramp rails 46L, 46R and then onward
31 as per normal south along the south bound rail track
32 12.

1 The non-intrusive turnout 10 previously described
2 herein has the great advantage that the rail tracks
3 12R and 14L do not require to be cut which would be
4 normal if a conventional intrusive temporary turnout
5 was to be inserted in to the tracks 12, 14.
6 Furthermore, those skilled in the art will
7 appreciate that, if a train requires to pass through
8 the non-intrusive temporary turnout 10 without
9 actually crossing over from one track 12 onto
10 another track 14, the ramp rails 22 or 46 as
11 required can be removed along with the respective
12 switch rails 24 or 44 and crossing rail 30L or 30R
13 and as such the train will be able to bypass the
14 non-intrusive temporary turnout 10.

15
16 An alternative non-intrusive turnout will now be
17 described with reference to Figs. 19 to 35.

18
19 The sequence of rail components length wise along
20 the track of the turnout of Figs. 19 to 35 is the
21 same as that for the non-intrusive turnout (Fig. 1)
22 i.e. from the left hand end of the left hand turnout
23 track 16, a pair of ramp rails 21, 22 followed by a
24 pair of switch rails 23, 24 followed by a pair of
25 gutt rails 25, 26, followed by a pair of crossing
26 rails 29, 30 etc.

27
28 The ramp rails 21, 22 and the means of connecting
29 the ramp rails 21, 22 (G-clamp mechanism 32,
30 represented by 32 in Fig. 26) in this alternative
31 are broadly similar to that of the previous non-

1 intrusive turnout, and thus require no further
2 description.

3
4 Following on from the ramp rails 21, 22, Figs 19A
5 and B along with Figs. 24A, B , C) shows a pair of
6 switch rail units generally designated 100
7 comprising a switch rail head 50, planar member or
8 plate 38, guide means 60 in the form of downwardly
9 projecting guide flanges 60, a pair of supporting
10 members 40, end plate 72, and support connecting
11 means 48 in the form of clips 48.

12
13 The switch rail head 50 essentially takes the form
14 of an upper portion of an I-shaped rail section
15 (shown during installation of the apparatus in Figs.
16 31A and B), and extends between one end of the
17 switch rail unit 100 and the other. The switch rail
18 head 50 is inwardly curved along its length toward
19 the south bound rail track 12 and thus away from the
20 north bound rail track 14, in a broadly similar
21 manner to that previously described (Fig. 1).

22
23 The planar member or plate 38 is rectangular in
24 dimension and is permanently attached to the switch
25 rail head 50 by any suitable means during
26 manufacture such as welding or moulding etc. The
27 plate 38 may or may not extend along the full length
28 of the switch rail unit 100; in the latter case, the
29 switch rail head 50 will overhang the plate member
30 38. This is best seen in Figs. 27A and 28A.

31

1 The pair of guide flanges 60 project downwardly from
2 the plate 38 and run parallel to the existing north
3 bound track 14 along the entire length of the switch
4 rail unit 100 and are displaced from the centreline
5 or the plate 38 by an amount which allows the inner
6 track of the existing north bound track 14 to fit
7 closely between the pair of guide flanges 60. The
8 skilled reader will realise that the guide flanges
9 60 may only be present at the extreme ends of the
10 plate 38.

11
12 Each supporting member 40 may be a wooden timber and
13 has a cross sectional shape which allows them to be
14 placed underneath the plate 38 and close around the
15 inner and outer neck portions of the existing rail.
16 The lower surface of each supporting member 40
17 together may also be adapted, during manufacture or
18 upon installation, to match the contours of a
19 variety of standard railway sleepers. The pair of
20 supporting members 40 are of a length, width and
21 position, substantially similar to that of the
22 plate 38, though it will be appreciated that longer
23 and or wider supporting members may be preferable
24 depending upon the individual situation parameters,
25 for example the alignment and or size of the gaps
26 between sleepers.

27
28 The clips 48 releasably attach the pair of
29 supporting members 40 to the plate 38, and are
30 designed such that they will hold the supporting
31 members 40 firmly against the planar member 38 in

1 the vertical direction, and against the existing
2 rail in the lateral direction.

3
4 The end plate 72 protrudes vertically downward from
5 the overhang created by the switch rail head 50 and
6 butts against the end of the inner supporting member
7 40.

8
9 It will be appreciated by the reader that in this
10 embodiment the supporting members 40 may be left in
11 position during normal running of the railway track
12 (as shown in Figs. 29A, B, C, D, E and F); that is
13 when no transfer of trains between one railway track
14 and another is required, so that there is no
15 crossover of a train 5 travelling on either north
16 bound track 14 or south bound track 12.

17 Alternatively the supporting members 40 may be
18 placed to one side ready for installation as shown
19 in Fig. 29G. Therefore the switch rail head 50 and
20 planar member 38 may be installed and removed with
21 relative ease and in a relatively short amount of
22 time as desired.

23
24 Following on from the switch rail unit 100 the
25 turnout next comprises a pair of gutt rails 25, 26.
26 The gutt rails 25, 26 are broadly similar to that
27 previously described, and thus require no further
28 description.

29
30 Following on from the gutt rails 25, 26, the turnout
31 next comprises a pair of crossing units generally
32 designated 200 (Figs. 20A, B and Fig. 30). Each

1 crossing unit 200 comprising a crossing rail head
2 50c, planar crossing member or plate 38c, guide
3 flanges 60c, a pair of supporting members 40c, a
4 pair of end plates 72c, and support connecting clip
5 48c.

6
7 The crossing rail head 50c has the same cross
8 sectional shape as that of the switch rail 50, (i.e.
9 upper portion of an I-shaped rail section), and
10 extends diagonally between one end of the crossing
11 unit 200 and the other, so as to point toward the
12 south bound track 12 and thus away from the north
13 bound track 14.

14
15 The crossing rail head 50c may span a longer
16 distance along the crossing unit 200 than the
17 crossing plate 38c and the supporting members 40c,
18 thus creating an overhang at either or both ends of
19 the crossing unit 200.

20
21 The crossing plate 38c, guide flanges 60c,
22 supporting members 40c, and support connecting
23 clips 48c are broadly similar to those of the switch
24 rail unit 100, and thus require no further
25 description.

26
27 The pair of end plates 72c protrude vertically
28 downward from the overhang created by the crossing
29 rail head 50c. Each end plate butts against the end
30 of a supporting member 40c.

31

1 The end plates 72 of the switch rail head 50, and
2 the end plates 72c of the crossing rail head 50c may
3 be drilled to suit a standard connecting means such
4 as a fishplate, in order to provide a secure
5 connection between each rail head component.

6
7 This non-intrusive turnout 10 has an advantage over
8 the previous alternative non-intrusive turnout 10 of
9 having additional support to the turnout track which
10 is provided by the supporting members 40, 40c whilst
11 still allowing the switch rail head 50, crossing
12 rail 50c, plate 38, and crossing plate 38c to be
13 removed and installed relatively easily, without
14 permanent alteration (i.e. cutting) of the existing
15 track.

16
17 Fig. 21A and B show an alternative version of the
18 crossing unit of a non-intrusive turnout, which will
19 now be described.

20
21 A partially supported crossing unit generally
22 designated 300 comprises a crossing rail head 50d,
23 and a tapered supporting member 40d.

24
25 The crossing rail head 50d is broadly similar to
26 that previously described e.g. 50c and thus requires
27 no further description.

28
29 The tapered supporting member 40d is wedge shaped
30 such that it fits in the gap created between the
31 crossing rail 50d and the existing rail near the
32 point of crossing over.

1 For each previously described non-intrusive turnout
2 10, when the ramp rails 21, 22, switch rails 23, 24,
3 and crossing rails 29, 30 are removed it is
4 preferable that the end of each gutt rail 25, 26
5 exposed to an oncoming train is provided with
6 deflecting means which deflect any loose items (not
7 shown) suspended below the railway carriage (not
8 shown) away from the gutt rails 25, 26, thereby
9 preventing such items from snagging on the gutt
10 rails 25, 26 which could otherwise result in
11 derailment of the railway carriage. Figs. 21A, B, C
12 and D show possible deflecting means for this
13 purpose. Each deflecting means is adapted to be
14 easily fitted onto the exposed end of the gutt rails
15 25, 26 by suitable means, for example a fishplate.
16 Prior to re-installation of the ramp rails 21, 22,
17 switch rails 23, 24, and crossing rails 29, 30, the
18 deflecting means will be removed.

19
20 Fig. 23A and B show alternative supporting means for
21 a switch rail and crossing unit of a non-intrusive
22 turnout, which will now be described.

23
24 Central level crossing support members 40e known and
25 used in the industry are wedged between the existing
26 rails and are supported by central supports 78c
27 which are connected to the existing sleeper 79. The
28 central level crossing support members 40e are
29 complimented by outer level crossing support members
30 400e which are supported by outer supports 78o.
31 Positioned between the outer level crossing support
32 members 400e and the inner level crossing support

1 members 40e are outer packing wedges 120 and inner
2 packing wedges 121. The outer and inner packing
3 members 120, 121 secure the level crossing members
4 40e, 400e in both the lateral and vertical
5 directions.

6
7 The switch rail head 50e and planar member 38e are
8 broadly similar to that described previously (Fig.
9 19) and are situated above the level crossing
10 support members 40e and 400e.

11
12 A similar adaptation is shown in Figs. 23C and D
13 making use of the level crossing supports 40e and
14 400e in the crossing rail unit.

15
16 This support arrangement has the advantage over the
17 support arrangements previously described in that it
18 allows the loads exerted by the passing train to be
19 transferred directly to the sleeper and existing
20 rail, whilst using currently available components.

21
22 However, it would be beneficial to reduce the height
23 of certain portions of the raised track surface,
24 specifically those portions which are intended to
25 remain in place between the pair or existing rails
26 in order to ensure that trains which pass along the
27 existing rails during normal running do not collide
28 with the raised track surface.

29
30 Referring to Figs. 36a, 36b, 36c, 36f, 37a, 37b,
31 37c, 38a, and 38b a first embodiment of non
32 intrusive crossover apparatus 500 (Fig. 38a) in

1 accordance with the first, second and third aspects
2 of the present invention will now be described.

3
4 The sequence of rail components length wise along
5 the track of the turnout of Figs. 19 to 35 is the
6 similar to that previously described with the
7 important difference of providing additional ramp
8 sections along the length of the crossover in order
9 to vary the height of the wheels as they are
10 crossing the railway tracks. From the left hand end
11 of the left hand turnout track 516L, a pair of ramp
12 rails 522L, 522r are followed by a pair of switch
13 rails 524L, 524r which have downwardly sloped ramp
14 portions 600 followed by a pair of gutt rails 525L,
15 525r which are at a lower height (typically a
16 maximum of 25mm above the uppermost surface of
17 existing rails 514 or 512) than the raised portions
18 which pass over the existing rails 514L, 514r. Up
19 until this point the right hand turnout track 516r
20 is substantially the same as the left hand turnout
21 track 516L. At this point the right hand turnout
22 track 516r then joins with upwardly sloped ramp
23 portion 602 of crossing unit 530r which rises to the
24 height required in order to cross the existing track
25 514L which is typically 50mm above the uppermost
26 surface of existing rails 514 or 512. In order to
27 avoid a discrepancy between the height of the raised
28 track surface on the left hand side and that on the
29 right hand side it is necessary to provide
30 compensation ramps 604 on the left hand raised track
31 surface. At this point the crossover repeats this
32 process in a mirror image to that described in order

1 to return the raised track to the opposite side of
2 the railway tracks 512l, 512r. The profile of this
3 undulation in height is illustrated by Fig. 38b.

4
5 The means of connecting the ramp rails 522L, 522r
6 (G-clamp mechanism 32, represented by 32 in Fig. 26)
7 in this embodiment are broadly similar to that of
8 the previous described non-intrusive turnout, and
9 thus requires no further description. However, an
10 alternative embodiment of the ramp rails in
11 accordance with the third aspect of the present
12 invention will be described subsequently.

13
14 Following on from the ramp rails 522L, 522r, Figs
15 37a, 37b and 37c show a switch rail unit generally
16 designated 524 comprising a switch rail head 550,
17 planar support member or support plate 538, guide
18 means 560 in the form of downwardly projecting guide
19 flanges 560, a pair of supporting members 540, end
20 plate 572, and support connecting means 548 in the
21 form of clips 548.

22
23 The switch rail head 550 essentially takes the form
24 of an upper portion of an I-shaped rail section and
25 extends between one end of the switch rail unit 524
26 and the other. The switch rail head 550 is inwardly
27 curved along its length toward the south bound rail
28 track 512 and thus away from the north bound rail
29 track 514, in a broadly similar manner to the that
30 previously described (Fig. 1). The switch rail head
31 550 has a downwardly sloped portion 600 at the end
32 of the unit 524.

1 The planar support member or support plate 538,
2 guide flanges 560, support members 540, clips 548
3 and end plates 572 are substantially identical to
4 that previously described and therefore will not be
5 described further.

6
7 Following on from the switch rail unit 524 the
8 turnout next comprises a pair of gutt rails 525L,
9 525r. The gutt rails 525L, 525r are located at a
10 height and location which coincides with the lower
11 end of the downwardly sloped portion 600 of the
12 switch unit 524.

13
14 On the right hand turnout rail 516r, following on
15 from the gutt rails 525r the turnout next comprises
16 a crossing unit generally designated 530 (Figs. 36a,
17 36b, 37c). Each crossing unit 530 comprising a
18 crossing rail head 550c, planar crossing member or
19 plate 538c, guide flanges 560c, a pair of supporting
20 members 540c, a pair of end plates 572c, and support
21 connecting clip 548c.

22
23 The planar member or plate 538c, guide flanges 560c,
24 support members 540c, clips 548c and end plates 572c
25 are substantially identical to that previously
26 described and therefore will not be described
27 further.

28
29 The provision of the ramp rails 522L, 522r, switch
30 rail 524L, 524r, downwardly sloped ramped portion
31 600, gut rails 525L, 525r, crossing unit 530r and
32 compensation ramps 604 of the turnout section

1 provides, when connected to another oppositely
2 arranged turnout section, a raised surface which
3 allows the train to travel from the first railway
4 track 514 to the second railway track 512 as
5 follows:-

6 The wheels are firstly raised (by about 50mm)
7 by ramps 522L, 522r onto switch rails 524L, 524r
8 which moves the wheels (and hence the train) away
9 from the existing rails 514L, 514r. This
10 effectively allows the flange of the wheel running
11 along the left hand rail to pass over the left hand
12 existing rail 514L;

13 Ramp portions 600 then lower (by approximately
14 25mm) the wheels onto gutt rails 516L, 516r which
15 transport the wheels further from the existing rails
16 514L, 514r;

17 The wheels are then raised (by about 25mm) back
18 up to the height which is substantially the same
19 height as that at which the left hand wheel
20 previously crossed the existing rail 514L. This now
21 has the effect of allowing the flange of the right
22 hand wheel to pass over the left hand existing rail
23 514L.

24 The wheels then continue until the left hand
25 wheel passes over existing rail 512r;

26 The wheels are then lowered (by about 25mm) on
27 ramp portions equivalent to 600 on the opposite end
28 of the non intrusive crossover section;

29 The wheels are then brought toward the second
30 railway tracks 512L, 512R by gutt rails 542L, 542r;
31 The wheels are then raised again (by about 25mm) via
32 ramp portions 600B such that the flange of the right

1 hand wheel running along the right hand gutt rail
2 542r may pass over existing rail 512r; and
3 the wheels are finally lowered (by about 50mm)
4 onto existing track 512l and 512r by ramp portions
5 523L and 523r.

6
7 Referring to Figs. 36e and 37e an embodiment of non
8 intrusive crossover in accordance with a second
9 aspect of the present invention will now be
10 described.

11
12 In this embodiment essentially the same switch
13 apparatus is provided as previously described for
14 the first embodiment with the important difference
15 that a hinging mechanism 700 is provided in order to
16 hinge the planar plate 1538 and the switch rail 1550
17 away from the supporting members 1540 when normal
18 running is desired; in other words the planar plate
19 1538 can be rotated about the hinge mechanism 700
20 from a first configuration in which the turnout is
21 in operation to a second configuration in which the
22 planar plate 1538 is clear of the existing rails and
23 thus normal running of trains on the existing rails
24 can occur. In the same way, hinging means 700 may
25 be provided on the crossover apparatus in order to
26 hinge the planar plate 1538c and the crossover rail
27 1550c away from the supporting members 1540c when
28 normal running is desired.

29
30 Referring to Figs. 39a, 39b, 39c and 39d an
31 embodiment of the ramp apparatus in accordance with

1 a third aspect of the present invention will now be
2 described.

3
4 The ramp apparatus generally designated 522 is
5 secured to the outer edge of an existing rail 514
6 and which is thus arranged on one side thereof by
7 clamps 576 in a similar manner as that previously
8 described. The ramp comprises a sloped portion 513
9 and a levelled portion 515 which are integrally
10 formed on a single member and which provide a rail
11 surface for a tread of the wheels to traverse. The
12 sloped portion 513 is provided with an introductory
13 or lead-in slope 517 which extends below the level
14 of the existing rail 514 on its outer edge. As
15 shown in Fig. 39b, the sloped portion 513 is tapered
16 to as low a height as possible (such as 10mm or so)
17 where it abuts against the upper surface of the
18 existing rail 514, though it will be appreciated by
19 the skilled reader that it is not possible to have
20 no height at the end of the taper especially since
21 such a thin area would be liable to succumb to
22 damage due to the train passing over it. In order
23 to mitigate this problem in addition to being
24 tapered with respect to height, the tapered end of
25 the sloped portion 513 is also angularly tapered
26 over the surface of the existing rail 514.

27
28 It will be understood by those skilled in the art
29 that train wheels 507 generally have a slightly
30 greater width than the rails on which they are
31 designed to run and therefore an overhang portion
32 (in the order of a few mm) is created (not shown)

1 where the outer edge of the wheel tread 509 does not
2 come into contact with the existing track 514
3 surface.

4
5 In operation, as the wheels 507 of the train pass
6 along the existing rail 514 and toward the ramp 522
7 the overhang portion on the wheels 507 will be
8 gradually introduced to the ramp by the introductory
9 slope 517. Thus when the rest of tread 509 of the
10 wheel abuts against the taper of the sloped portion
11 513 there will be a smooth transition from the
12 existing rail 514 to the slope 513 and on towards
13 the levelled portion 515. This is beneficial since
14 it minimises the damage to the tapered portion of
15 the ramp 522.

16
17 It should be noted that the embodiments of the
18 invention described allow a train to be transferred
19 from a first railway track to a second railway track
20 without permanently damaging either the first or
21 second railway tracks, and that the invention
22 described allows particular sections of the non-
23 intrusive crossover section to be left in position
24 during normal running of the track i.e. when it is
25 not desired to transfer the train from the first to
26 the second track. The embodiments described also
27 allow those sections to be left in place without
28 contravening specific requirements relating to the
29 height (such as 25mm) which components protrude
30 above the ground during normal running.

31

1 Modifications and improvements may be made to the
2 embodiments described herein without departing from
3 the scope of the invention.